

Pedagogical Issues and E-learning Cases: Integrating ICTs into Teaching and Learning process

BY

Elijah I. Omwenga, omwenga@uonbi.ac.ke

University of Nairobi
School of Computing and Informatics
P. O. Box 30197

Abstract: Classical instructional methods have been used and will continue to be used in the teaching and learning process. However, their limitations in different circumstances vary depending on student and instructor needs, where they are and who they are.

In this paper we consider issues and implications of ICT-supported learning with regard to pedagogy in the teaching and learning process. We will consider the context of developing ICT methodologies and strategies which can be integrated into the teaching and learning process within schools and higher learning institutions.

The paper first presents a background and a justification for the underlying work. Approaches that can be applied to integrating ICTs effectively in the teaching and learning process are then discussed. Intelligent teaching and learning methods are then considered and issues on how to ameliorate the impediments are discussed within the schools' and higher learning institutions' set-ups respectively. The paper ends by making some recommendations and a conclusion at the end.

1. Introduction

Information Communication and Technologies (ICTs) provide a window of opportunity for educational institutions and other organizations to harness and use technology to complement and support the teaching and learning process. E-learning is an example of the use of these ICT-supported teaching and learning methods whose use in educational institutions is gaining momentum with the passage of time (Omwenga, June 2004). In this regard the emerging and evolving changes in the teaching and learning requirements and needs will be addressed in this paper.

Educational systems around the world are under increasing pressure to use the new information and communication technologies (ICT) to teach students the knowledge and skills they need in the 21st century. Within the past decade, the new ICT tools have fundamentally changed the way people communicate and do business. They also have the potential to transform the nature of education: where and how learning takes place and the roles of students and teachers in the learning process.

The challenge confronting our educational systems is how to transform the curriculum and teaching-learning process to provide students with the skills to function effectively in this dynamic, information-rich, and continuously changing

environment. ICTs provide an array of powerful tools that may help in transforming the present isolated, teacher-centred and text-bound classrooms into rich, student-focused, interactive knowledge environments. To meet these challenges, learning institutions must embrace the new technologies and appropriate ICT tools for learning. They must also move towards the goal of transforming the traditional paradigm of learning.

For example, recently the government of Kenya through the Ministry of Education launched a multi-million Information and Communication technology Trust Fund. In his speech, at a graduation ceremony for ICT graduands at the Kenya Institute of Education on November 28, 2004, the minister for education said that the government was committed to providing 2500 of the 3500 public secondary schools in Kenya with computers by the year 2008. The ministry is embarking on this ambitious programme to connect all primary and secondary schools to the Internet in 10 years. The Education permanent secretary announced that six schools would benefit from a pilot programme to be officially launched on September 29 2005 (Daily Nation, July 6, 2005). We note that Kenya is among 16 countries selected to benefit from the first phase of the e-initiative by the New Partnership for Africa's Development (Nepad). The programme is to provide knowledge and real-life experience by implementing information communication technologies (ICT) in schools across Africa that will inform the model for a large-scale rollout. The Permanent Secretary (PS) said that the Government had entered into an agreement with Microsoft to supply computers to schools and that Sh1.5 million had been released to buy the machines. "We are committed to integrating ICT into our education system and are investing in access, equipment and skills," the PS said.

The private sector is doing a commendable job in introducing ICT to schools. One such non-governmental organization is Computer for Schools - Kenya whose mission is to provide Kenya's youth with access to modern Technology through donation of computers to Kenyan Public secondary Schools. As at now, 300 secondary schools have so far been supplied with computers. Kenya Schoolnet is also another private organization that has taken the initiative to start a Trainer Of Trainer training programme.

Barclays bank of Kenya is also one such private company that has also donated computers to schools. In 2004 it donated 20 computers to a public secondary school in Nairobi.

But the question is, are these computers being used to enhance teaching and learning in our secondary schools? In the current curriculum, computer studies is a separate learning activity/subject. Learners are being taught how to be computer literate, and not how to use computers to enhance learning. We need models to serve as examples of how computers can be used to promote learner-centred education and the approach used reflects a general movement away from "teaching computers" toward using ICT as educational tools: integration of ICTs in the teaching and learning process Muriithi (2005).

2. Integration

Computer integration in the classroom is the application of technology to assist, enhance, and extend student knowledge. Using ICT in education means more than

simply teaching learners how to use computers. Technology is a means for improving education and not an end in itself. Thus, ICT should also be used to promote information literacy – the ability to access, use and evaluate information from different sources in order to enhance learning, solve problems and generate new knowledge.

According to Reform Forum (April 2003) - Journal for Educational Reform in Namibia - Information Technology literacy is very different from being able to integrate technology into teaching to enhance learning. In other words, being “digitally fluent” means not only knowing how to use the technological tools, but also knowing how to construct things of significance with those tools. Teachers do not need to learn about technology; they need to learn how to use technology to enhance their learners’ understanding and critical thinking skills. Enhancing basic information and communication skills like reading, writing, and speaking should be the focus of using ICT in education, not simply ICT literacy.

Muriithi (2005) has argued that in Kenya like most developing countries ICT usage is still limited to computer literacy training. She contends that the present ICT curriculum merely deals with ‘teaching about computers’ and not how computers can be used to transform the teaching and learning in our schools. In her thesis, she says that integration should consider learning pedagogy, the pattern of student use of ICT, and the extent of use in teaching and learning programmes. A wide range of learning technologies should be selected and incorporated into the teaching and learning program.

2.1 Pedagogical Implications

In a recent survey done by Muriithi (2005), it was realised that 75% of teachers in secondary schools would encourage learning by discovery with an almost similar number supporting learning through project work. However, majority of the teachers (72%%) are for the idea that instruction should be built around problems with clear correct answers, and around ideas that most students can grasp quickly. These findings have significant pedagogical implications regardless of whether these statements of teaching philosophy carry over to teachers' actual teaching practice. Their endorsement for good teaching is consistent with constructivist instructional reform.

2.2 Theoretical Underpinnings and The Constructivist Approach

Newhouse (2002) in his paper ‘The Impact Of ICT On Learning And Teaching, A literature review’, for Western Australian Department of Education, the learning environment as having a physical as well as a relationship dimension has been described. Physically it may be in a room, full of particular furniture and equipment. Curriculum materials such as books and videotapes may also be present.

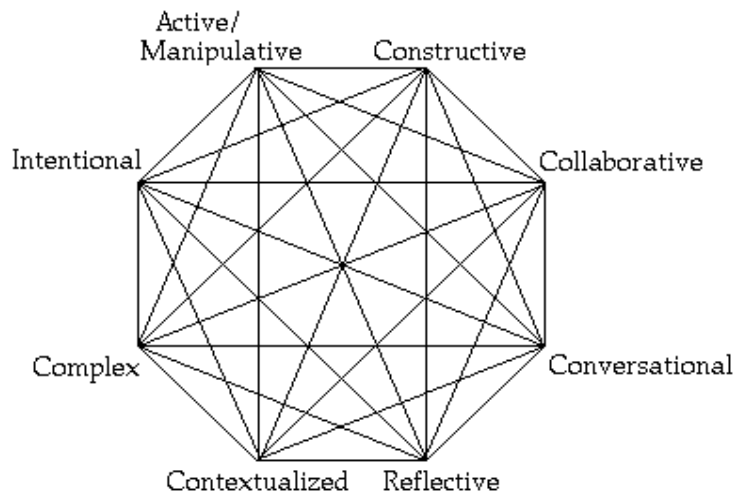
The curriculum also has a place in the relationship dimension of the environment in that the students and teacher(s) are focused on certain processes and content in the curriculum and have a relationship with that curriculum and the methodologies that are associated with conveying the curriculum. Students and teachers may have very different relationships with different components of the curriculum.

In 2000 the U.S.A. Committee on Developments in the Science of Learning addressed the issue of what should be considered in developing learning environments in their report *How People Learn: Brain, Mind, Experience, and School*. They defined “four interrelated attributes of learning environments that need cultivation” Newhouse (2002).

- Schools and classrooms must be *learner centred*
- To provide a *knowledge-centred classroom environment*, attention must be given to what is taught (information, subject matter), why it is taught (understanding), and what competence or mastery skills are expected.
- *Formative assessments* - ongoing assessments designed to make students’ thinking visible to both teachers and students are essential - to help both teachers and students monitor progress.
- Learning is influenced in fundamental ways by the *context* in which it takes place.

A community-centred approach requires the development of norms for the classroom and school, as well as connections to the outside world, that support core learning values. This structure provides an ideal and thereby throws some challenges at education systems. Some of these challenges may be met with ICT support.

The following characteristics of meaningful learning provide guidelines for designing constructivist learning environments as outlined by Duffy, et. al (1993).



Learning environments should emphasize the qualities illustrated in the figure above. What do these mean?

- *Active*: Learners are engaged by the learning process in mindful processing of information where they are responsible for the result.
- *Constructive*: Learners integrate new ideas with prior knowledge in order to make sense or make meaning or reconcile a discrepancy, curiosity, or puzzlement. They construct their own meaning for different phenomena.

- *Collaborative*: Learners naturally work in learning and knowledge building communities, exploiting each others skills while providing social support and modeling and observing the contributions of each member.
- *Intentional*: Everything that we do is intended to fulfil some goal. When learners are actively and wilfully trying to achieve a cognitive goal, they think and learn more. Learning environments need to support learners in articulating what their goals are in any learning situation.
- *Complex*: Problems are multiple components and multiple perspectives and cannot be solved in predictable ways like the canned problems at the end of textbook chapters. We need to engage students in solving complex problems as well as simple problems.
- *Contextual*: learning tasks that are situated in some meaningful real world task or simulated in some case-based or problem based learning environment are not only better understood, but also are more consistently transferred to new situations.
- *Conversational*: Learning is inherently a social, dialogical process. That is, given a problem or task, people naturally seek out opinions and ideas from others.
- *Reflective*: Learners should be required by technology-based learning to articulate on what they are doing, the decisions they make, the strategies they use, and the answers that they found.

3. The Constructivist Approach Vs. Intelligent Teaching and Methodologies

Duffy et al. (1993) has identified tools for building a Constructivist Learning Environment (CLE). In his article 'Designing constructivist learning environments', Duffy emphasises *Problem/Task Representation Tools* as being helpful in developing the Learners' mental models of objects, systems, or other phenomena that bring about visual/spatial capabilities. Visualization tools help learners to construct those mental images and visualize activities. *Static and Dynamic Knowledge Modeling Tools* on the other hand enable learners to use dynamic modelling tools for building simulations of those systems and processes and for testing them. Other tools include the following:

Performance Support Tools - CLE automates algorithmic tasks in order to offload the cognitive responsibility for their performance. Most forms of testing in CLE should be automated so that learners can simply call for test results.

Information Gathering Tools - embedding search tools may facilitate learning. Sophisticated search engines (many with graphical interfaces) and intelligent agents are in common use for seeking out and filtering information sources on the WWW and selecting information that may be relevant to the user.

Conversation and Collaboration Tools - Conversations may be supported by discourse communities, knowledge-building communities, and communities of learners. The learning community environments should support reflection on the knowledge constructed and the processes used to construct it by the learners.

The parallel between the constructivist approach and ICT-supported education may only get better. Already, most e-learning environments take into consideration these new approaches to teaching and learning.

3.1 Instructional processes in CLE

All instructional activities need to be appropriately supported in a CLE. The goals for providing this instructional support can be grouped into three main areas:

Modelling: Modelling primarily deals with demonstrating to the learner how (and why) to perform the activities necessary for the completion of some task or objectives. This can be done by providing examples of the desired performance. The objective is to articulate the reasoning and decision making issues involved in each step of the process.

Coaching: The main objective of coaching is to intervene at critical points in the instruction in order to provide the learner with encouragement, diagnosis, directions and feedback. It can be as simple as providing a series of timely pre-programmed hints, or as complex as analyzing what the learner is doing and offering help if the learner seems to be lost.

Scaffolding: The main objective of scaffolding is to adjust the task for the learner to match his/her level of performance. In the long run, the objective is to remove all support systems when the learner is ready to think on his/her own. It takes into consideration the systemic factors that may affect performance. It focuses on the task, the environment, the teacher and the learner.

4. ICT Education for Schools, Colleges and Universities

4.1 ICT Education and Training

An ICT Education curriculum would be concerned with **what** is learned and taught and **how** learning and teaching occurs. What is learned/taught includes objectives, content, and learning outcomes (the knowledge, skills and attitudes that students are intended to demonstrate). The “how” of the curriculum concerns teaching/learning methodology, teaching strategies and media resources.

Educational technology concerns the technology that is used to facilitate the teaching/learning process. As such it is included in the *how* part of the curriculum. The technology used is determined by the intended curriculum. Also, part of the context of the curriculum concerns the role of the teacher, the physical setting and the general pedagogical views of the teacher and education system. These are likely to affect the technology used.

So in many ways technology can be seen to be affecting the curriculum both in terms of content and methodology. The existing Computer Science syllabi may not be appropriate to enable the integration of ICT into teaching and learning.

According to the Reform Forum (2003), ‘While the existing syllabus may help a select group of learners prepare for a career in Computer Science, this approach to computer training for the average learner is similar to teaching learners every part

of a pencil before allowing them to draw. The problem is that, it brings the learners to view computers as exceedingly complex pieces of electronics without giving them any particular idea of how to effectively use them toward any valuable end in the real world.

4.2 The role of the government

Many governments in the African continent including the East African region have realized the benefits of using ICT in educational reforms. The Ministers for Education, Science and Technology have stressed their governments' commitment in promoting the usage of ICT in education. For instance, in his speech at a graduation ceremony for the Kenya Institute of Education, Kenya's minister for Education noted: "during the African Government Leaders Forum on the African digital divide held in Johannesburg, South Africa, in September 2003, Kenya successively negotiated to be included in the Partners in Learning Initiative (PLI) programme sponsored by Microsoft, the leading computer software provider". This is encouraging as it shows renewed interest by the private sector as well as donors to support the development of ICT using the "school" as the Platform of choice. The private sector and development partners will no doubt provide the necessary links in terms of skills and above-all in mobilization of critical financial resources to ensure sustainability in the long-term.

Education and training have a major role to play in the implementation of the ICT policies at national level. The success in the use of ICT in all sectors will require sufficient and competent human resource that is well developed and equipped in the education and training sector. The successful introduction and use of ICT in education and training institutions will play a major role in disseminating skills to the wider society

4.3 Educational Reform Success

It has been observed that even in situations where teachers have been trained in the use of ICT, the integration of these technologies in the teaching of subjects has been weak because of a number of reasons:

- Absence of systematic management support;
- Lack of ownership by schools;
- Lack of integration into existing curriculum and textbooks;
- Teacher overload and lack of incentives and motivation;
- Lack of ICT-based materials that are truly interactive for teachers to use; and
- Shortage of personnel

The absence of policies and management support to the use of ICT in schools is hindering the progress of the use of ICT in the classrooms. It is not uncommon that one comes across computers in schools not being used because they are out of order and there is no technical support to repair them; the computers cannot be accessed because they are locked away in computer rooms after school hours; or there is lack of funds for developing educational software to make the hardware become productive.

4.4 ICT Education in Schools: A survey

4.4.1 Need for a Framework for ICT Education in Schools

Realising the potential benefits of ICT has been shown over the years to be difficult to achieve unless it is clear what capabilities the students are being expected to develop in the course. Without a clear overview of the learning processes required to develop such capabilities, there is a tendency for ICT to be “bolt on”, time-consuming and costly to implement and its benefits remain unclear or dubious.

Newhouse (2002) has come up with a Teacher Professional ICT Attributes Framework, Prepared for Western Australian Department of Education. The model presents a framework of ICT integration to support student learning in schools. It includes an outcome for teachers, guidelines, instruments and processes involved in this integration.

The framework proposes five dimensions:

- Students (ICT Capability, Engagement, Achievement of Learning Outcomes)
- Learning Environment Attributes (Pedagogic Practice) [Learner-centred, Knowledge-centred, Assessment-centred, Community-centred]
- Teacher Professional ICT Attributes [Vision & Contribution, Integration & Use, Capabilities & Feelings]
- School ICT Capacity [Hardware, Connectivity, Software, Technical Support, Digital Educational Resources]
- School Environment [Leadership & Planning, Curriculum Organization, Curriculum Support, Community Connections, Accountability]

To implement this framework one needs to look at it from the context of processes conducted by schools and/or systems. Broadly there are six sets of processes a school may take to support progress in the use of ICT:

- School planning for ICT to support learning and teaching,
- The development of student ICT literacy,
- The use of learning and information management systems,
- The development of school ICT policy and planning,
- The development of staff ICT capabilities, and
- The development of policy and planning for system support and direction.
- Teacher’s decision-making about using ICT.

This framework mainly focuses on *Teacher Professional ICT Attributes*. We also need to look keenly at other dimensions because they go hand in hand if we are to achieve the goal of integrating ICT in the classroom successfully. Other frameworks exist and they focus on six dimensions namely; *Planning, Integration and Use, Staff Capabilities, Electronic Educational Resources, Hardware, and Connectivity*.

In all the frameworks studied, it is clear that the major areas of interest are the learners, the teachers, the learning environment, the school ICT capacity, the school organization and cultural values. These frameworks act as a good basis for developing a framework for integrating ICT in teaching and Learning in the East African region.

4.5 ICT Education in Higher Learning Institutions

In (Omwenga et. al. 2004) a model for introducing e-learning in higher learning institutions has been described in detail. The model, shown below, identifies a number of key steps which include Benefits Analysis, Evaluation of Current status, Development of work plan, Implementation and Validation, and Review and Maintenance. The step, benefits analysis will spell out the reasons for deploying the technology while evaluation of the current status is the stage that will establish what exists and the appropriateness of that technology for the curriculum. Then the rest of the stages will follow possibly with iterations if some of the results of the post-implementation review are not adequate. During the study, a detailed questionnaire was used to collect the information. A cross section of staff who included opinion leaders within the university were asked to give their views on issues pertaining to specific stages. Their responses were evaluated - results of which were used during subsequent stages.

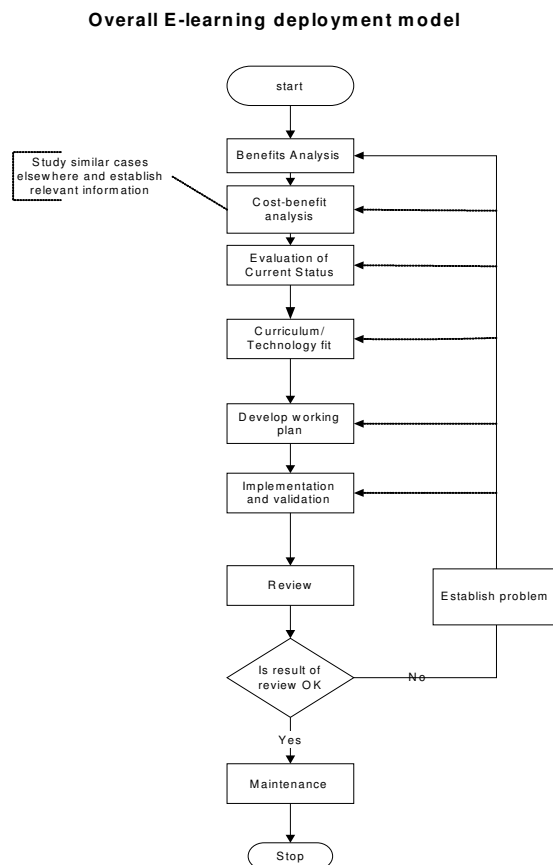


Figure 2: E-learning deployment model

4.5.1 ICT Facilities: Barriers

Low investment in ICT infrastructure coupled with high cost of connectivity and bandwidth are two major problems that hinder effective use of the resources available on the Internet. In a conference of Vice-Chancellors, Provosts and Deans of

Science and Technology faculties from several Universities from across Africa (ANSTI, Nov. 2005), the need to develop ICT strategic plans and policies with strong representation and voice at university top management was highly recommended. During the conference, most universities reported poor or minimal access to online journals to facilitate research. It was however, noted that some of the free resources available are quite good and should be recommended for use.

In the (ANSTI, Jul. 2005) report on science and technology status in Africa, the average staff-Computer ratio for Science and Technology faculties in most African universities was found to be about one computer per two staff members. This ratio could be increased by investing more into computer acquisition through a cost sharing model where staff are assisted to purchase computers through a recovery mechanism. In the same report, it is evident that there is need to improve access to ICT facilities in order to effectively deploy them in institutions of higher learning. The study showed remarkable disparities in the number of computers in each of the 20 universities surveyed from across the African continent. On average the analysis showed that there are about 6.5 computers per basic science course and about 9.1 computers per engineering science course. It was also noted that in general, very few departments provide computers to all of their staff. In fact only 1 out of 3 departments across disciplines had more than half of their staff who have computers in their offices.

These statistics point to a situation that require a substantial input of resources in order to achieve an efficient ICT infrastructure and access that will be supportive to the improvement of teaching and learning. These findings can easily be generalised given that Science normally is more ICT- oriented than other subjects.

4.5.2 Possible Intervention Mechanisms

To ameliorate the situation, (ANSTI, Nov. 2005) recommended the need to establish ICT units within universities. These units should have well trained technical manpower to effectively manage network and the bandwidth resources. For such units to be sustainable, ICT budget lines must be included in the overall university financial plans to cater for maintenance and expansion of the ICT infrastructure and the acquisition of monitoring and management tools.

On the issue of poor access to online journals, there is need to create networks of researchers around the world who can provide an environment of resource sharing and exchange of articles. This will not only deal with poor access to journals and other resources but also enable researchers to be aware of recent advances in their area of specialisation.

Infrastructure plays a key role in the implementation of research activities including the above identified problem of poor online access and Internet services. The conference further proposed that there is need to develop cost recovery plans for ICT investments.

Conclusion

The paper has considered issues and implications of ICT-supported learning with regard to pedagogy in the teaching and learning process. The context of developing

ICT methodologies and strategies which can be integrated into the teaching and learning process within schools and higher learning institutions have been considered and solutions to ameliorate the situation put forward.

Reference:

1. African Network of Scientific and Technology Institutions (ANSTI). (Nov. 2005). *Action plan from the First African Regional Conference of Vice Chancellors, Provoosts and Deans of Science, Engineering and Technology (COVIDSET 2005)*. Accra, Ghana 15-17 Nov. 2005. UNESCO, Nairobi.
2. African Network of Scientific and Technological Institutions (ANSTI). (July 2005). *State of Science and Technology Training Institutions in Africa*. UNESCO, Nairobi.
3. Durrington, V.A, Repman, J. and Valente, T.W. (2000) 'Using social network analysis to examine the time of adoption of computer-related services among university faculty', *Journal of Research on Computing in Education*, Vol. 33, No. 1.
4. Duffy T., Jonassen D., Lowyck J. (1993), *Designing constructivist learning environments*, Springer-Verlag.
5. IDRC (2001) 'Workshop for the evaluation of the Acacia supported schoolnet projects in Sub-Saharan Africa (Lesotho, Namibia, Senegal, South Africa and Uganda)', Johannesburg, 23-26 January.
6. Ministry of Education Science and Technology. Website www.education.go.ke, accessed in Nov. 2005.
7. Muriithi P. (2005). A framework for integrating ICT in the teaching and learning process in secondary schools in Kenya. MSc. Thesis submitted at the University of Nairobi, School of computing and Informatics.
8. Newhouse (2002), *The Impact Of ICT On Learning And Teaching*, A Literature Review, Western Australia Department Of Education.
9. Omwenga, E., Waema, T., & Wagacha, P. (June 2004). *A model for introducing and implementing e-learning for delivery of educational content within the African context*. *African Journal of Sciences and Technology* 5(1) 35-48.
10. Reform Forum(April 2003). *Journal for Educational Reform in Namibia*, Volume 16.
11. UNESCO World Education Report(1998), *Teachers and Teaching in a Changing World*.